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ABSTRACT

This environmental unit is one of a series designed for integration within an existing curriculum. The unit is self-contained and requires little teacher preparation. The philosophy of the units is based on an experience-oriented process that encourages self-paced independent student work. The purpose of this unit is to provide educational and enjoyable outdoor activities for students of all ages. The unit is divided into four sections, the first of which being concerned with seed dispersal. In the second section, students investigate goldenrod galls and the environmental influences on the wasps that hatch from them. In the next section, students study the succession of plant decomposition, and finally, they observe soil organisms and study the environmental factors that affect those organisms. The activities can be modified for use with students in all grades. Information provided includes a list of materials needed, directions, and student worksheets. (MA)

THE ENVIRONMENTAL UNITS

This is one of a group of Environmental Units written by the Environmental Science Center and published by the National Wildlife Federation.

In both theory and practice education is the essential base for long-range local, regional and national programs to improve and maintain the quality of environment necessary for man's welfare and survival. Citizens must be aware of ecological relationships in order to recognize, appreciate and fulfill constructive roles in society. This awareness should be launched through the existing educational process — in classroom and related school activities. No special courses on ecology can replace the need to integrate ecological learning throughout the existing curricula of our school systems. Furthermore, the life-styles and value-systems necessary for rational environmental decisions can best be acquired through repeated exposure to ecological learning which pervades the total educational experience.

It was with these thoughts that we developed these curriculum materials. They were designed for the classroom teacher to use with a minimal amount of preparation. They are meant to be part of the existing curriculum — to complement and enhance what students are already experiencing. Each unit is complete in itself, containing easy-to-follow descriptions of objectives and methods, as well as lists of simple materials.

The underlying philosophy throughout these units is that learning about the environment is not a memorization process, but rather an experience-oriented, experiment-observation-conclusion sort of learning. We are confident that students at all levels will arrive at intelligent ecological conclusions if given the proper opportunities to do so, and if not forced into "right" answers and precisely "accurate" names for their observations. If followed in principle by the teacher, these units will result in meaningful environmental education.

In the process of development, these units have been used and tested by classroom teachers, after which they have undergone evaluations, revisions and adaptations. Further constructive comments from classroom teachers are encouraged in the hope that we may make even more improvements.

A list of units in this group appears on the inside back cover.

About the National Wildlife Federation—1412 Sixteenth Street, N.W., Washington, D.C. 20036

Founded in 1936, the National Wildlife Federation has the largest membership of any conservation organization in the world and has affiliated groups in each of the 50 states, Guam, and the Virgin Islands. It is a non-profit, non-governmental organization devoted to the improvement of the environment and proper use of all natural resources. NWF distributes almost one million copies of free and inexpensive educational materials each year to youngsters, educators and concerned citizens. Educational activities are financed through contributions for Wildlife Conservation Stamps.

About the Environmental Science Center—5400 Glenwood Avenue, Minneapolis, Minnesota 55422

The Environmental Science Center, established in 1967 under Title III of the Elementary and Secondary Education Act is now the environmental education unit of the Minnesota Environmental Sciences Foundation, Inc. The Center works toward the establishment of environmental equilibrium through education—education in a fashion that will develop a conscience which guides man in making rational judgments regarding the environmental consequences of his actions. To this end the Environmental Science Center is continuing to develop and test a wide variety of instructional materials and programs for adults who work with youngsters.

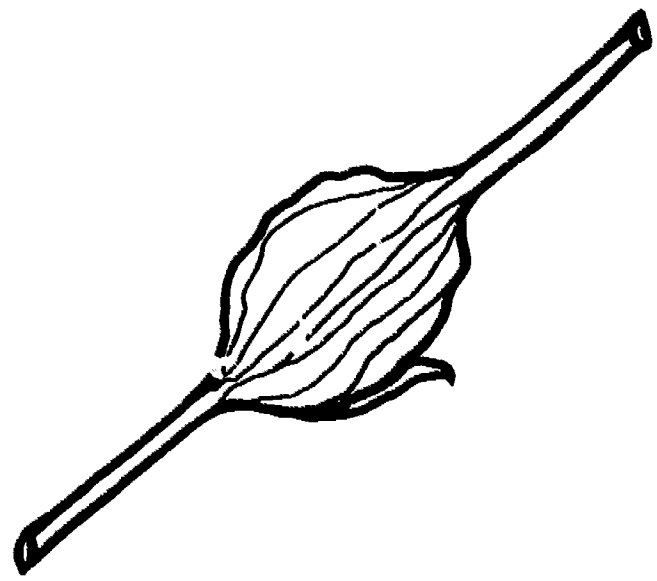
Outdoor Fun for Students

An Environmental Investigation

BY

NATIONAL WILDLIFE FEDERATION

MINNESOTA ENVIRONMENTAL SCIENCES FOUNDATION, INC.



Design and Illustrations by
JAN BLYLER

Environmental education should be a challenge, but it should also be worthwhile and fun. If students find the out-of-doors to be enjoyable and interesting, chances are they'll want to return to it again and again. Hopefully, they'll also want to preserve this outdoor classroom.

Outdoor Fun for Students was designed with these ideas in mind. The goal is to expose students to a variety of activities which demonstrate that creatures interact with their habitats, and that the students do the same. The activities are intended as suggestions. We hope you will expand and enhance them as best suits the needs of your students.

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INTRODUCTION

The intent of this unit is to bring together a number of activities which are unusual, which have not been elaborated upon in other sources, and which emphasize relationships within the environment. The activities range in complexity, but, with some imagination, can be made relevant for almost any grade level.

In the first section, students will investigate some of nature's ways of dispersing seeds and burs.

In the second section, the students will take a close look at the growths commonly found on goldenrod plants. These growths are called goldenrod galls. The students will investigate varying environmental influences on wasps which hatch from these galls. In this section students will also look at other insects which they find in an open field and try to discover possible relationships between those insects and their environment.

In the section including the Succession Activities, the class will observe fruits and vegetables over a period of time to detect patterns in the decomposition process. Another separate activity involves students in using different colored toothpicks as an aid in learning about some of the factors influencing natural selection.

In the final section, students will investigate organisms found in soil samples and how conditions in the soil can affect those organisms.

The investigations themselves are intended to be both educational and enjoyable. We hope, ideally, that you will relate these activities to events or aspects of your neighborhood and community. The greatest educational value of the activities lies in their potential for creating awareness and social concern for the environment.

MATERIALS

bur-attracting clothes
plastic bags
large sheets of paper, white and dark
trowels
access to a refrigerator
assorted burs
gravel
soil
small boxes or other containers
glass jars
glue
nylon stockings
sponges
thermometers
razor blades (optional)
tree identification book
pencils
boxes of colored toothpicks
magnifying glasses
dissecting microscope (if possible)

Outdoor Fun for Students

Autumn Seed and Bur Activity

Nature has its own way of distributing seeds and burs so that plants can grow in different areas. Sometimes unsuspecting animals become carriers when seeds or burs get caught on their fur. In this first activity, a "Bur-In," children will discover for themselves how burs and seeds get transported. To begin with, the class will need to find out the best clothes to wear on a Bur-In.

Collect some burs or "stick-tights." Pass the burs around and have each child place the burs on all different parts of his clothing. The purpose is to see which types of clothes are best suited for attracting burs. Resolve to wear those kinds of clothes on the field trip. Or, make leggings of appropriate material (woolly material is excellent, old sheets will work) by wrapping pieces of fabric around the children's legs and pinning them with safety pins.

I. "Bur-In" Field Trip

Select a weedy, brushy area for the Bur-In--a vacant lot or an old field that has grown up to weeds. Ask the students for suggestions of locations, if you wish, but be sure to check out the area before the field trip. Especially, check to make sure that there isn't poison ivy in the area. Describe poison ivy to the children. It is often bright red or mottled red and yellow in autumn, with white berries. Warn the children to avoid picking the white berries or touching the leaves. Have the children wash their hands thoroughly with yellow soap once they're back in the classroom, just in case.

Go to the site of the Bur-In with the class. Have the students walk, run, skip, roll in the grass, play hide-and-seek, pick up litter, look for interesting discoveries, walk through tall weeds, form a long line and walk side by side, arms-distance apart across the area (this may even scare up some mice, rabbits, or birds), and so forth.

Have the students collect one sample of as many different kinds of plants which produce burs or sticky seeds as they can find. They should put these into plastic bags to take back to the classroom.

II. Follow-up

Return to the classroom and have each child remove the burs from his clothing and put them on his sheet of white paper.

On a large class poster board or a large sheet of white shelf paper or butcher paper, have the members of the class glue an example of each type of sticky seed. If anyone has a sample of the plant from which a particular bur came, have him glue it beside the bur.

You might want to have a contest and determine who has the greatest number of burs, as well as who has the greatest number of different kinds of burs.

FOR DISCUSSION:

Why do burs stick to people? Do burs stick only to people? What's inside a bur? Which burs stick the best? What might happen to a bur that caught on a fox's tail? What kind of bur is most common? Did different kinds of burs come from different locations? What do burs look like under magnifying glasses?

Planting Burs

Have the students put several of each kind of bur in a refrigerator for about a week. Also set aside several of each kind of bur that has been placed in the refrigerator. Those set aside should be kept at room temperature while the others are in the refrigerator. (If your area of the country has cold winters, the seeds may need to be cold and dormant before they can germinate.) The class may also want to plant some burs in potted soil and leave the pots in the refrigerator for an extended period of time—perhaps three weeks.

At the end of a week, have the students remove the unplanted burs from the refrigerator. Then have them put a little gravel into several containers and fill the containers the rest of the way with soil. You will want two containers for each type of bur. In half of the containers, have the students plant the burs which have been refrigerated, and in the other containers have them plant the burs that have been kept at room temperature.

Each planter should contain several of **only one variety of bur.**

On each container, have the students label "refrigerated" or "unrefrigerated" along with a sketch of the kind of bur each planter contains.

Seeds should be watered occasionally—very lightly, just to keep the soil from drying out.

Once the plants start to grow, they will probably need a lot of sunshine. Have the students sketch the plants at different stages of their development. Discuss with the students whether the plants look like any they have seen before.

ASK THE STUDENTS:

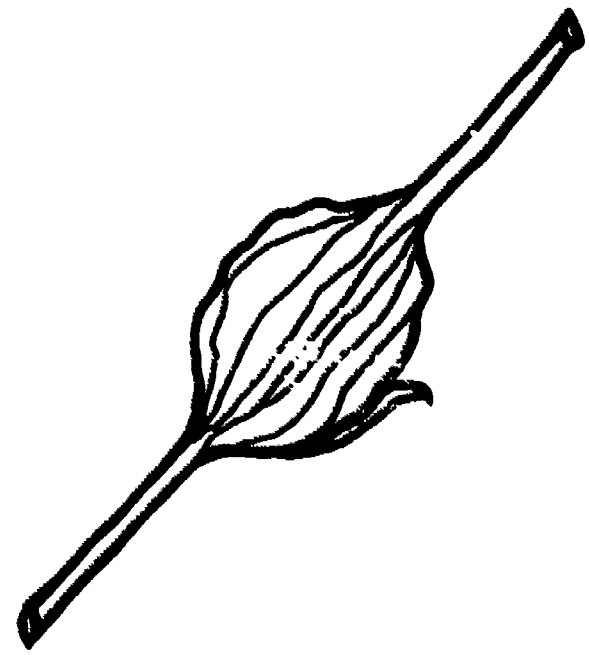
Did any type of bur that had not been refrigerated fail to sprout? Did any type of bur that had been refrigerated fail to sprout? Do you detect any difference in the amount of time needed for sprouting between those burs that had been refrigerated and those that had not? Do some burs sprout regardless of whether they have or have not been refrigerated prior to planting?

What's in a Goldenrod Gall?

I. Background

The tall, common goldenrod plant remains standing through the winter, though it is dead and dry. You can find it in, or at the edge of, open meadows and fields. Often the dry plants have an egg-shaped swelling on the stem. This is the **goldenrod gall.**

The gall swelling is caused by the goldenrod wasp which lays its eggs in the stem when the plant is green and growing, during summer. The egg, and



larva that hatches, irritate plant tissues, which in turn swell to form the gall.

The inner lining of the gall serves as food for developing wasp larva after it hatches from the egg.

II. Field Trip

One of the important aims of this activity is to observe the wasps emerging from the galls. Not every gall will produce a wasp. The activity involves using the galls to make three different types of preparations. Each of these preparations will in turn be studied under seven different environmental conditions, or tests, to determine how the varying conditions affect the emergence of the wasps. For each preparation, it is necessary to have a minimum of seven galls, for a total of twenty-one galls for the entire activity. It is desirable, however, to have at least fourteen galls per preparation, making a total of forty-two for the activity. By having extra galls for each preparation you partially compensate for the fact that some galls will not produce wasps.

Take your students on a hunt for goldenrod galls during February or March. Look in almost any vacant lot, field, weedy ditch, or border area. Have a number of paper bags available for collecting the galls.

Try to maintain as much suspense as possible during this investigation. It is not necessary to tell the children what they will find inside the galls. During the observation period, they will see the little worm-like creature—the larva—become a pupa and then an adult wasp.

About two to three weeks after bringing galls in, the wasps will begin to emerge. (THESE WASPS DO NOT STING OR BITE!) If the children have not been told that a wasp will make his appearance, they will be much more excited when he does.

III. What To Do With a Gall Collection

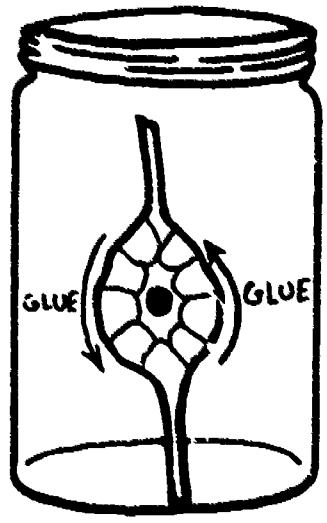
A collection of galls can be examined in a number of ways. Here are some suggestions. You may think of others.

Preparation I.

Carefully cut seven or more galls open with a razor blade or sharp knife. (You will want to caution your students to be careful using the knife or razor blade. If your students are young, you will want to do the cutting yourself.) Make the cuts parallel to the stem, but off-center. The larva should not be disturbed by this since it lies in the center of the cavity.

Trim each cut so that the larva is clearly visible. Have the students place glue around the **perimeter** of the cuts and fasten each gall to the inside face of individual glass jars. This forms a window through which the larva can be viewed.

PREPARATION I

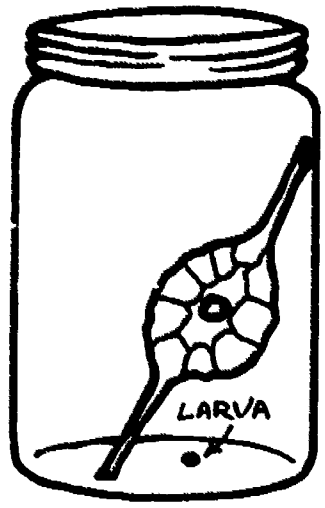


Then the students should cover each jar with a piece of nylon stocking. This allows air to enter. Each of the jars should be labelled "Preparation I" so they can be referred to later.

Preparation II.

Cut seven or more galls the same way as that described in **Preparation I.** Remove the larvae from the opened galls and place each larva in an individual glass jar. Have the students cover each of the jars with nylon stocking material and label them **"Preparation II."**

PREPARATION II



Preparation III.

Leave at least seven galls unopened. Have the students put each of these galls in an individual glass jar with a nylon stocking cover. These jars should be labelled **"Preparation III."**

A. Observations

The children will make observations and discoveries, usually without your urging. For example, they might discover that:

—The larva eats out an "escape tunnel" for the wasp before the larva becomes a pupa.

—The pupa is hard and oval, and does not move

The wasp pushes through the skin of the gall by inflating a balloon on his head.

The wasp has folded, crinkled wings immediately after emerging.

After emerging, the wasp sits on the gall until the wings straighten out and the balloon on his head collapses.

B. When Environment Changes—What Then?

Light, moisture, temperature, air movement—these are some of the elements that make up environment. Ask the children what they think happens to living things when these elements change. Do they think the larva in the goldenrod galls will be affected by environmental changes?

Depending on the number of galls you have collected, have the students make some or all of the following tests - or devise your own. You could have each group keep a single set of records or possibly each student in the group could keep his own personal records. At the bottom of this page is a portion of a sample data sheet like one on which students can record their findings. In the back of the book, we have provided complete data sheets which you can duplicate and give to your students for Tests I, II, and III (pages 16-18).

Test I: **Does the amount of light affect the development of the larva?**

To shut out the light, have students fasten dark paper around one or more containers of galls from each preparation. They should leave the same number from each *respective* preparation in the light —in other words, if two galls from Preparation I are darkened, then two should be left in the light; if one is darkened from Preparation II, keep one in the light from that preparation, etc. Make sure all containers are in roughly the same location according to temperature.

Have the students observe and record any changes, according to date and Preparation. Note that in making any comparisons in this and in the following two tests, you will want to remind the students to keep the variable factor limited to one. If you have more than one variable, conclusions would be difficult to substantiate. For example, if you compare a container from Preparation I in the light with a darkened one from Preparation II, there are two variables - **light** and **type of preparation.** Valid generalizations in this case would be difficult to make.

Test II: **Does the amount of moisture affect the development of the larva?**

Have the students keep dampened sponges in one or more containers of galls from each preparation. There should be the same number of containers without sponges from each *respective* preparation. Make sure all the containers are left in roughly the same location according to light, temperature and other environmental factors. The students should moisten the sponges every day. Have them observe and record any changes according to date and Preparation.

Test III: **Does temperature affect the development of the larva?**

Have the students take several thermometers and find two spots in the room which remain at different constant temperatures. For example, they might find a warm spot near a radiator and a cool spot near the door. They should check these two spots each day for several days to make sure the temperatures are nearly constant (within a variation of five degrees).

When two spots have been found, the students should place one or more containers of galls from each of the three preparations in these places. Again, have the same number from each respective preparation in each spot. Don't let the students forget to check the containers daily. They should keep a daily temperature record, and note what's going on in each container each day.

ASK THE STUDENTS:

Do environmental factors affect the galls, and if so, how? What would happen if we had left the galls outside? What factors would influence their growth? Do you think that the galls might affect the goldenrods? How might they do so?

Test No. 1

LIGHT	NO LIGHT
Date	
OBSERVATIONS	OBSERVATIONS

LIGHT	NO LIGHT
Date	
OBSERVATIONS	OBSERVATIONS

LIGHT	NO LIGHT
Date	
OBSERVATIONS	OBSERVATIONS

A Field of Insects

This section works best in an open, grassy field. During spring, summer and fall, different plants come into blossom, go to fruit or nut, and then die off. During these stages, insects visit the plants for a variety of reasons. To investigate the insects that visit the various blossoms, your students will need an insect net. In the back of the book are plans for constructing a simple insect net. Ready-made nets can also be purchased from biological supply houses for about $4.00.

The point of this activity is to have the students sweep over flowers in the field, a single species at a time, to determine which types of insects frequent which types of flowers. In carrying out the activity, you may want to have members of the class work as a single group, or divide the class into smaller groups, or have the students work as individuals. Whichever way you plan the activity, have the students begin by selecting separate areas of the field that are individually abundant with a single type of flower, i.e., a section of the field that is all clover, a section that is all black-eyed susans, etc. Then have the students sweep the areas one at a time. To "sweep" the area, have each student hold the net with the opening sideways, then swing the net across in front of his body, and then turn the net and swing it back across in a figure eight. At the low loops of the figure eight, the net should brush down the vegetation.

The students should realize that they might not see the insects until they are in the net.

From each area that is swept over, the students may have a collection of insects. The insects gathered from one area should be kept separate from those gathered at another. As each area is swept over, have each student or each group make a separate killing container by pouring about three tablespoons of denatured alcohol into a plastic bag.

If you are carrying out the activity on an individual basis, each student will need to have a separate plastic bag with alcohol for the insects gathered from different flower species. If you have the activity organized with small groups, you could have the members of each group sweep a given type of flower and then all the members of each group could put their insects into a single group bag. After the insects are in the bags, have the students close the bags with a wire twister.

For mounting the insect collections, give the students heavy paper or cardboard and white glue. You may want to have a single class display, or have each group or each individual make a separate display, depending on how you have organized the activities. Allow the alcohol to dry before mounting the insects. Students can mount each insect by putting a drop of glue on the paper, placing the insect on top of the glue and gently settling it into the drop. The glue will become almost clear when dry.

Next to the insects collected from each flower species, you might want to have the students place a pressed, dried sample of the given flower. Press the flower in newspaper beneath heavy books for two or three weeks. When dried, place a square of transparent plastic food wrap over the flower and tape it to the paper or cardboard on which the insects are mounted. Have the students label their collections, indicating the locations where the insects were gathered as well as the date when the collections were made.

During the season different flowers bloom at different times. As the various plants bloom, you can have the class make additional insect collections. By making a series of collections for each blossoming plant, comparisons and correlations can be made.

ASK THE STUDENTS:

Is there one kind of insect which is found in great numbers for a particular type of blossom? Are there some blossoms which insects do not seem to visit? Do some insects appear in greater numbers than others in the field as a whole? Do some colors seem to attract insects more than others? Are there some insects which are found during certain times of the season but which are not found at all during other times? Are those insects which visit "good smelling" flowers different from the insects which visit "bad smelling" flowers? Do certain types of insects visit only one *color* of flower?

Insects and flowers are only one link in an almost endless chain of environmental relationships. In the next section the students will glimpse the larger picture by investigating succession.

Succession Activities

I. Background

People who work with the natural environment speak of the "balance of nature." This "balance" is not a steady, unvarying state. It is a condition in which each of thousands of factors—including wind, trees, birds, dust, houses and ants—interact and co-exist.

These factors get into balance by influencing each other for a long period of time—several years or several thousands of years.

If one factor in the balance is altered or removed, it will usually result in an unpredictable change among thousands of other factors which were originally in balance with the one that has changed. Generally, it is impossible to predict what changes the single factor might bring about in all the others, because it is impossible to measure all the ways the one factor has affected the others.

Change brings about "imbalance." Sometimes this imbalance will hardly be perceptible. Sometimes the imbalance will result in an extremely different behavior in the other factors. This new behavior may last only a short time until a new balance is established. Whether one factor or many are changed, or whether the results are hardly perceptible or great, there will always be a new balance which is different from the original one.

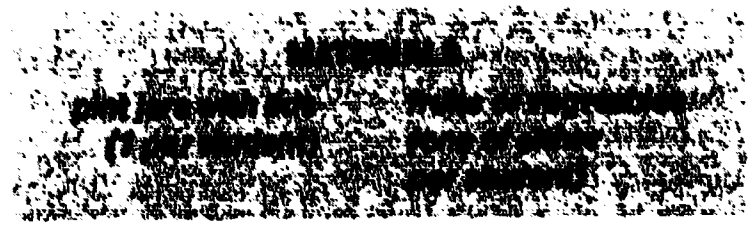
This change in balances is called **succession**. It is a natural process which usually occurs very slowly. But man's technology has caused great changes within natural settings. Because of this, succession has been proceeding much more rapidly in recent years.

In many instances, man is now able to predetermine some of the "natural balance" changes which his technology can cause. Before succession proceeds at such a fast rate that man cannot keep pace, it is important for all of us to understand how succession works.

The following activities aim to acquaint students with the phenomenon of succession and make them aware of their involvement with it.

II. Decomposition and Succession

The specific objective of this activity is to have the students observe the change brought about through decomposition of plant material and note the associated occurrence of successive mold growths. While this activity is conducted mainly in the classroom, the kinds of changes the children will have a chance to observe are similar to many of the changes which occur in the natural world.



Have each child choose a fruit or a vegetable that he can collect in the local area or bring from home.

On the day when you plan to begin this activity, have each student bring his fruit or vegetable to class. Each student should then put his selection in a jar. They should all seal their jars with lids. If some of the students have large fruits or vegetables, these should be cut into sections and part of them put into jars.

Have each student label his jar with his name and the name of the fruit or vegetable contained inside.

Set the jars aside where the children cannot see them. The jars should all be kept in the same location so that each jar will be exposed to approximately the same degree of heat, light, and other environmental factors. Decide upon a certain time each week when the students will make observations of their fruit or vegetable and record any changes that have taken place over the week. You may want to have the students check their jars several times a week. Have each student keep his observations in a notebook. Continue to make these observations over the entire school year.

Keep a class chart of information on the bulletin board noting all significant changes. T ings to watch for and include on this chart would be:

a. the first fruit or vegetable to become molded (give name of fruit or vegetable and describe mold)
b. the first to become discolored (give name of the fruit or vegetable and describe discoloration)
c. the first to release a juicy substance in the bottom of the container
d. the first to become misshapen
e. the first to collapse
f. the first to form a second discernible type of mold.

At the end of the year or when the fruits and vegetables have all become completely decomposed, number the bottles. Do this without the children knowing. On a separate sheet of paper, record for your own information which number belongs to which student and what fruit or vegetable was contained in the jar. Then remove the name tags and the labels telling the kind of fruit or vegetable that had been contained in each jar. Mix up the jars so the children can't recognize their own jar by its position on the shelf.

Have the children see how many of the fruits and vegetables they can identity in the decomposed state. They could write the jar number down and their guess beside the number.

Ask each child to retrieve a jar which contains the type of fruit or vegetable he originally brought. (He does not necessarily have to retrieve his own jar —just one containing his *type* of fruit or vegetable.)

There may not be enough jars for each child to choose one like his own, since some students may guess incorrectly. Some students therefore can just write down the number of a jar which they feel originally contained the same kind of fruit or vegetable that they brought.

ASK THE STUDENTS:

How many children were able to retrieve a correct jar? What characteristic did they use to identify the correct jar? Who identified the most fruits or vegetables correctly? What were the characteristics the children used when they correctly identified a fruit or vegetable?

III. Natural Selection Upon Toothpicks*

Children often come to think of the appearance and actions of a plant or animal as something of that organism's own choosing. The cat stalks the bird because the cat is naughty. The plant grows a flower because it wishes to be beautiful. The fish comes to the side of the aquarium because he wants to be fed. Cattails grow in the pond because they like the water.

The problem is mainly one of language and oversimplification. Language was developed to express ideas and information from a human point of view —that is, a point of view which assumes that humans make decisions and choose their actions. It is accurate to say, "John puts on his coat because it is cold outside." This implies that John chose this action and he probably did. However, we run into the risk of confusing a child's understanding of reality when we use the same language to refer to the behavior of something that is not human. To say, "The horse puts on his 'winter coat' because it is cold outside" is not wrong, but it is not realistic either. It states something about a horse in the same language used for John, and to the child, this implies that the horse also chose its action.

We may never get away from our language problem. But we can use another means of communicating the reality of an organism's situation. In this case, activities in which the children actually take part can provide a greater latitude of insight than verbalized instruction. The following activity deals with a concept that is often misrepresented by verbalized instruction.

A. Background

Most insects that live on plants are green or grayish in color. Ask the children to think of insects they have seen on plants and describe their color. The children will probably recall brightly colored insects but they will rarely mention insects which are green. This is probably because they cannot see green insects as easily.

Insects that live on the ground are usually brown or black. The children may agree here. But most insects that live on the ground are very tiny (pinhead size). Usually the ground insects that children know are large ones that can be spotted more easily because of their size.

We might attempt to explore the fact that most insects that live on plants are green (or that most soil insects are brown or black and small) by stating verbally "The insects are green (or brown or black and small) so that people or predators cannot see them." We would be linguistically logical but realistically quite wrong for we would again be implying that the insects *choose* to be green. The more realistic statement is, "Most insects found on plants are green because they cannot be seen." This may not make much sense at first, especially to the children. Rather than trying to explain it by words, the following activity is intended to help students understand the concept through experience.

*Adapted from *Grade Teacher*, January, 1969, p. 105 and David J. Kuhn, *The Science Teacher*, January, 1969, p. 68.

B. Outdoors

Get several boxes of colored toothpicks and separate the toothpicks according to color. Count the number in each color, take the number that is the smallest, and use this as your standard quantity. Gather that many toothpicks of each color and mix all the colors together. Then, before class, scatter them widely over some outdoor area. For instance, you could place them on a lawn, on open dirt, on a playground, in leaf litter, under some trees, on the sidewalk, and so on. Work the toothpicks into the grass or litter.

Present the activities to the children as a game. They will play the part of birds who are hunting insects for food. The children can't use their hands to feel for food since birds do not have hands. The children can only use their hands to pick up what they see.

Show the children what the "insects" will look like by displaying a sample of each color of toothpick. Then give each child a bag.

Take the children outdoors to the "insect hunting site" and let them go to work. Call time after five or ten minutes. The children should collect the toothpicks in the bags. You might want to provide each child with a chart of colors to check off numbers of the insects as he collects them. Or you might want them to make their own.

In class, or outdoors if it's nice weather, tally up the number of toothpicks of each color that have been collected by the students. Record this information on a large class chart.

Generally, if you have scattered the toothpicks widely enough, called time soon enough, and if you have made sure that one or more of the colors matches the surroundings in the collecting site, there should be differences in the numbers recovered in each color group. In green grass, there should be fewer green toothpicks recovered. Among autumn leaves, the children should find fewer yellows and browns.

If the toothpicks had really been insects, and the children had really been birds, and the birds were to keep hunting for insects all season, the children should be able to offer their own hypotheses about which color insects would most likely survive the season.

In your original activity, you may have scattered the toothpicks on green lawn. Would the children's hypotheses still hold if the toothpicks were scattered in other areas such as playgrounds, gravel areas, etc.? Use the same proportions of toothpicks regardless of location.

Have the children predict what color insects can most easily hide in the other areas.

The activities are intended to bring out the point that insects do not *choose* their color.

Rather, those insects which happen to be the "better" color for camouflage purposes will be more likely to survive.

FOR DISCUSSION:

How do most insects which live on plants come to have a green color? What can we say about the color of other kinds of insects or creatures such as those living on the ground? How is insect color related to succession or change in insect communities?

In this activity, the children have had a chance to look at one aspect of habitat *on* the land. Now their attention will be directed to creatures which live *in* the land—that is, the community found within the soil itself.

Creatures and Communities

I. The Soil is Alive—and Hungry

A. There is Action in the Soil

Do the students ever wonder what happens to the leaves, bugs, berries and small animals that die and fall to or remain on the ground?

Does something eat them? Do they simply rot away?

Actually, there is a whole world of living creatures in soil. The remains of plants and animals which lie on, or in, the dirt are chewed up and decomposed by these various organisms.

Some organisms prefer certain types of materials over others. Leaves are popular with many of them. It is easy and interesting to dig down and find out which hungry soil organisms prefer leaves . . . and what leaves they like best.

Divide the class into six or eight teams.

B. Where to Collect the Soil

Each team will need a large plastic box with a cover, a digging tool, paper and a pencil.

Teams should take their equipment to an area chosen previously—a woods, meadow, or other relatively undisturbed place. The most "alive" soil is found where man has disturbed it least. There are many more soil organisms in a meadow, for example, than in a field that is plowed each year. Sandy soil has fewer organisms if there is no ground cover such as dried grass. After arriving at the chosen site, have each team carefully dig up some of the top layer of ground, putting enough in its plastic box to cover the bottom with about one inch of soil. (All teams should get soil from the same general area, although the general area could cover several hundred square feet.) Each team should remove all growing plants and dead leaves from the soil in its box.

Have each team draw a small map of the total area from which all the teams are taking samples, marking on its map the location of its own sample. Later, when the students are back in the classroom, you can have them draw a large class map of the general area from which samples were collected. On this map, have each team mark the location of its sample, along with identifying landmarks such as trees, hills, etc.

It is also important to know something about the specific area from which each soil sample was taken. Is it from a field covered mostly with grass or from a forest? Is the area under a tree or out in the open? Is the area in the middle of brush and small trees? Is the ground covered with vegetation or dead leaves? On a sheet of paper, have each team describe the plants or trees growing in its own soil sample location.

Now have the students from each team pick up some soil from their sample and work it with their fingers. Each team should describe the moisture content of its sample.

Dry soil is crumbly, feels dry, falls apart easily when you handle it.

Moist soil feels damp, or maybe spongy.

Wet soil drips when you pick it up or squeeze it.

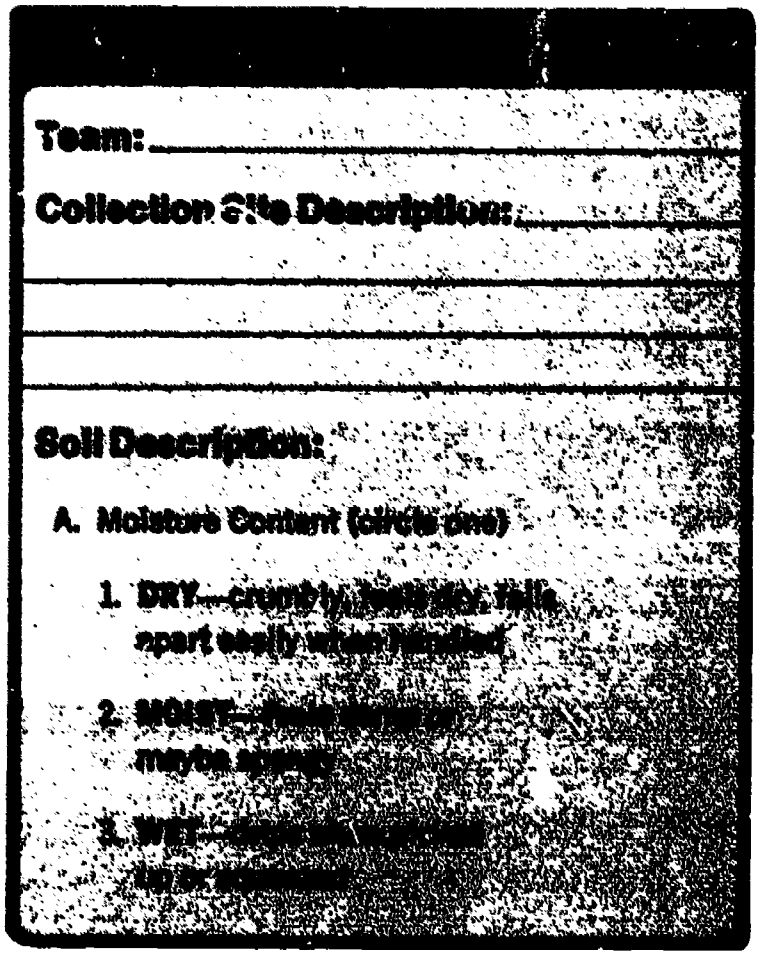
Now they should describe the texture of their soil samples.

Sandy soil is made up of grains of sand.

Clay soil sticks together in clumps, has lots of clay in it.

Loamy soil is made up mostly of dead leaves and other organic matter.

A portion of a sample data sheet follows. We have filled it in with plausible findings. A blank copy of the complete data sheet is included in the back of the book, page 19, in case you would like to duplicate it for your students.

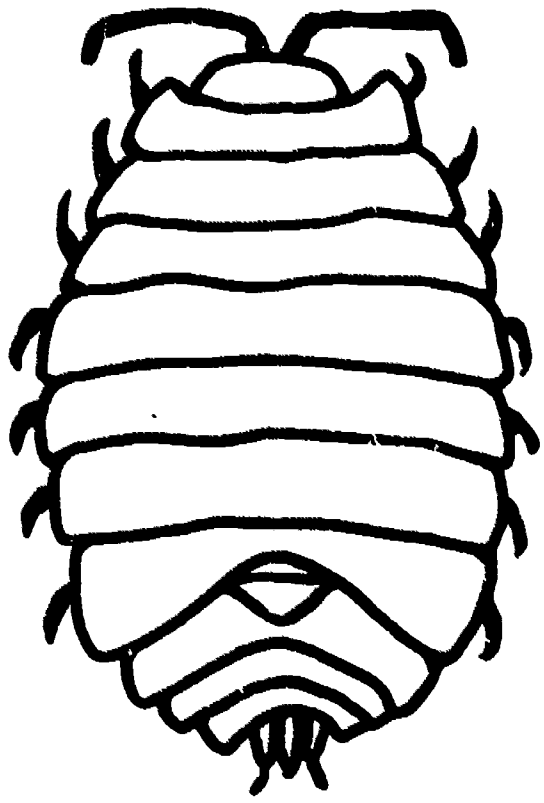


C. To Start Action in the Soil Boxes

Next have the students look for sowbugs and leaves. You may choose to have the students do this activity at the same time they are collecting their soil samples. If you choose to collect the sowbugs and leaves during a second field trip, the soil samples can be left on a shelf in class. The new materials can be collected in plastic bags and put into the soil boxes once back in class. If the soil is left on the shelf, it should be kept covered to prevent drying out.

Each team should collect its own sowbugs and leaves. Have the students look in cool, dark, moist places for sowbugs or pillbugs. They should check

under logs, stones, boards, leaves and in other places to find these little isopods. The sowbugs look like this:



Each team should catch about ten of these bugs. The students can use their hands, for the bugs will not bite. They should put the bugs in their team's soil box or plastic bag.

Have each team find one dead leaf from three or four different kinds of trees. Have them try to find leaves that haven't been chewed or broken. Leaves should be chosen from the following table, if possible. You may need a tree identification book to find the various types. Each team should choose only one leaf from a group, but it should make sure that it has at least three groups of leaves represented. Dead leaves can probably be picked up under the trees. Live leaves which are picked off a branch, may be "killed" by submerging them in boiling water for a minute or two.

Group I
1. black elder
2. hornbeam

Group II
1. alder
2. ash
3. elm

Group III
1. spruce
2. beech
3. red oak
4. pine
5. Douglas fir
6. larch

Group IV
1. basswood
2. maple

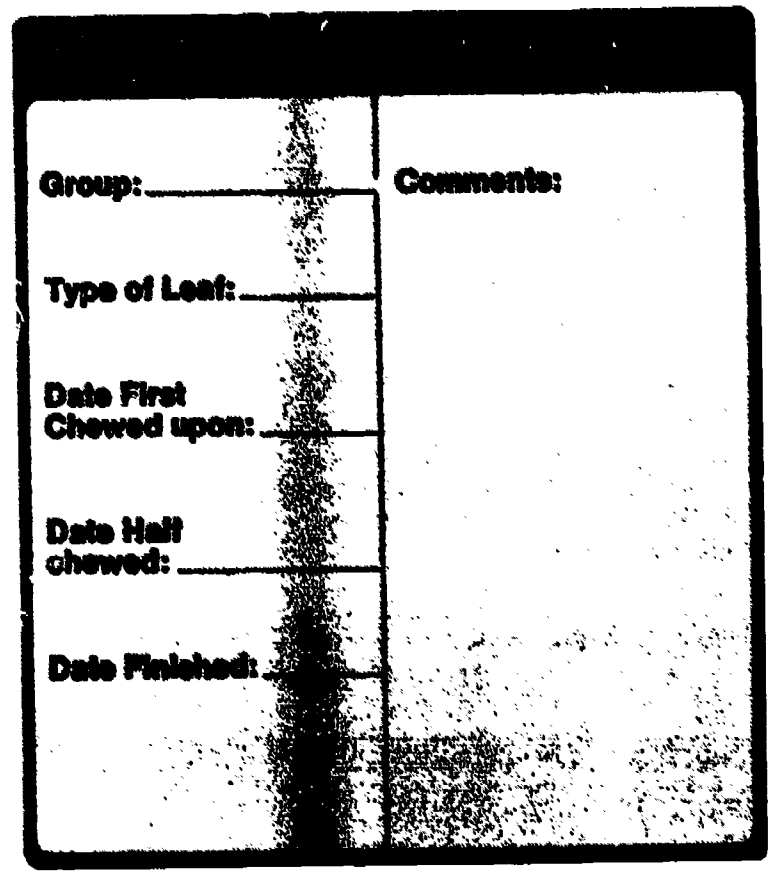
Group V
1. oak
2. birch
3. aspen

Each team should put the leaves from different groups in its soil box, laying them flat on top of the soil. Have them put in the sowbugs, too, if they haven't already done so.

When everything is inside, the cover should be secured and the box placed somewhere that is easily accessible—away from heat and sunlight. If the top is kept on, the box should stay moist enough for the soil organisms. If the soil starts to dry out, it can be sprinkled very lightly with water. The students should check the boxes every day.

D. Watch the Box and Record Activity

Have each student watch his or her team's box carefully. Ask: Do you see any signs of life besides the sowbugs? (There may be some worms, insects or spiders.) Have students record their findings on a team data sheet. A portion of a sample follows. A blank copy of the complete data sheet has been provided in the back of the book, page 20.



Students should inspect the dead leaves in the boxes very carefully each day. Ask: Have any leaves been chewed? Which of the three or four types of leaves appear to be the most appetizing to the soil organisms? Have the students record their findings on team data sheets.

After several days, have them compare observations with those of other teams to see if they can work out a list of leaves which get chewed up and decomposed first.

For example, if every team which had a maple leaf or a linden leaf in its box found that this leaf was chewed on the first day, before any other kind of leaf was touched, these leaves would be the most appetizing to the soil organisms. If elm leaves are chewed next, these would be second in order of preference.

Students may be able to tell which organisms are eating the leaves by actually catching them in the act, or by finding their droppings. Sowbug droppings are small, brown and rectangular.

The leaves that are being decomposed in the soil box may be chewed in different patterns. Some leaves may be eaten out between the veins, some may be chewed full of holes, and some may be simply devoured from one edge to another. Ask the students if the eating patterns are different on their various leaves.

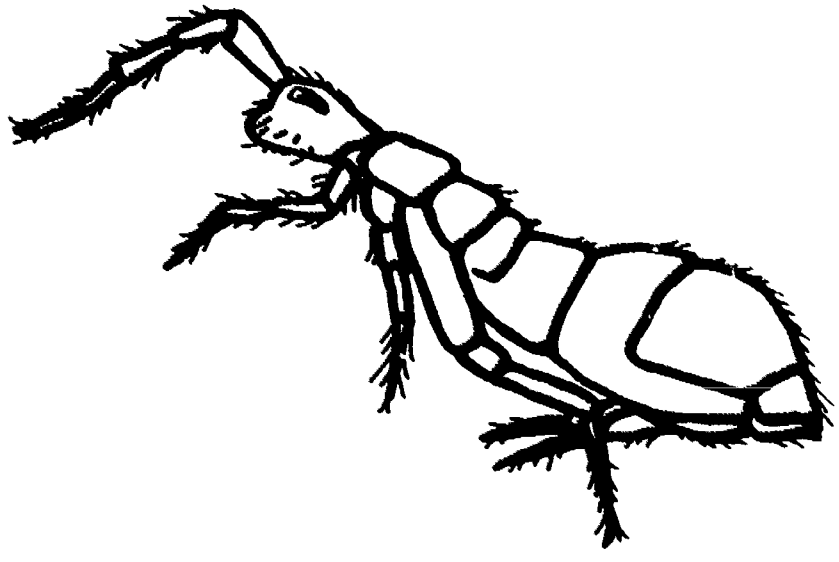
Have students from each team draw a picture or "map" of each of their team's leaves. They should indicate in different colored crayon or chalk how much is eaten each day. They may also want to take pictures of their leaves each day.

E. Other Creatures Decompose Leaves, Too

Several other creatures, besides the sowbug, help decompose leaves.

Earthworms ingest (eat) particles of leaf and mix them with soil in their bodies. Their droppings, called earthworm "castings," help to enrich the soil, and their burrowing helps to aerate the soil.

Springtails are small insects which appear in large numbers in the soil. Most of them have spring-like contraptions on their abdomens that enable them to catapult several inches into the air when disturbed. Most springtails eat decaying vegetation.



Small mites, relatives of the spiders, are about the size of a pin prick and are usually present in even larger numbers in the soil than springtails. Most of these are predatory, living on springtails and other small soil animals.

There may be 1,000 springtails and 2,000 mites in three cubic inches of natural forest or meadow soil. Springtails and mites will probably be the animals the students will notice most often on the leaves in their soil box.

If the soil is moist or wet, there may also be some slugs and snails. If the soil is too moist, mold will grow.

II. Effect of Soil Moisture on Garden Slugs

Slugs react to the amount of moisture in the soil by laying different numbers of eggs. In fact, soil moisture is an important factor in the lives of all soil organisms. By conducting this simple slug experiment, students can begin to understand one way soil conditions can affect organisms. In the activity, students will prepare soils containing different amounts of moisture and count the number of eggs laid by the slugs in each soil sample.

Slugs can be found quite easily in damp places where there is an abundance of rotting vegetation. Students should look closely in gardens, fields, and around the edges of ponds. Their most likely hiding place is beneath matted vegetation.

To each of four wide mouth jars, have each team add one eighth cup peat moss or other moisture-holding material mixed with one cup of dried soil. To one of its four jars, each team should add one sixteenth cup of water; to a second, one eighth cup of water; to a third, one fourth cup of water; and to the fourth, one half cup of water. Make sure each team labels each of its jars with the amount of water added.

On the surface of the soil in all four jars, have each team lay a flat piece of wood, tar paper or cardboard. Each team should add five slugs to each of its jars. Each jar should then be covered with a piece of cloth fastened down with a rubber band.

Students should check the jars each day for five days. Have them count, record, and remove the eggs laid by the slugs each day. The eggs appear as groups of round, shiny, white spheres about the size of a pin head. Most eggs will be found on the bottom surface of the flat material. However, students should check the entire surface of the soil. Ask: What is the total egg production for each jar? Have students compare the data taken for the different jars. What conclusions does the class come to?

Moist cotton is a good incubating material for the eggs removed from the jars each day. Put the cotton in another jar or jars, place eggs in with it, and keep the eggs there for about 3 weeks. After ten days, have students examine the jar daily and count the number of eggs hatched. (Young slugs can be fed lettuce.)

ASK THE STUDENTS:

How does moisture affect garden slugs? What is the average length of incubation for slug eggs?

*Adapted from Lewis, Trevor and L. R. Taylor. New York: Academic Press, 1967. p. 137.

Test No. 1

Preparation I		Preparation II		Preparation III	
LIGHT	NO LIGHT	LIGHT	NO LIGHT	LIGHT	NO LIGHT
Date:		Date:		Date:	
Observations:	Observations:	Observations:	Observations:	Observations:	Observations:
Date:		Date:		Date:	
Observations:	Observations:	Observations:	Observations:	Observations:	Observations:
Date:		Date:		Date:	
Observations:	Observations:	Observations:	Observations:	Observations:	Observations:

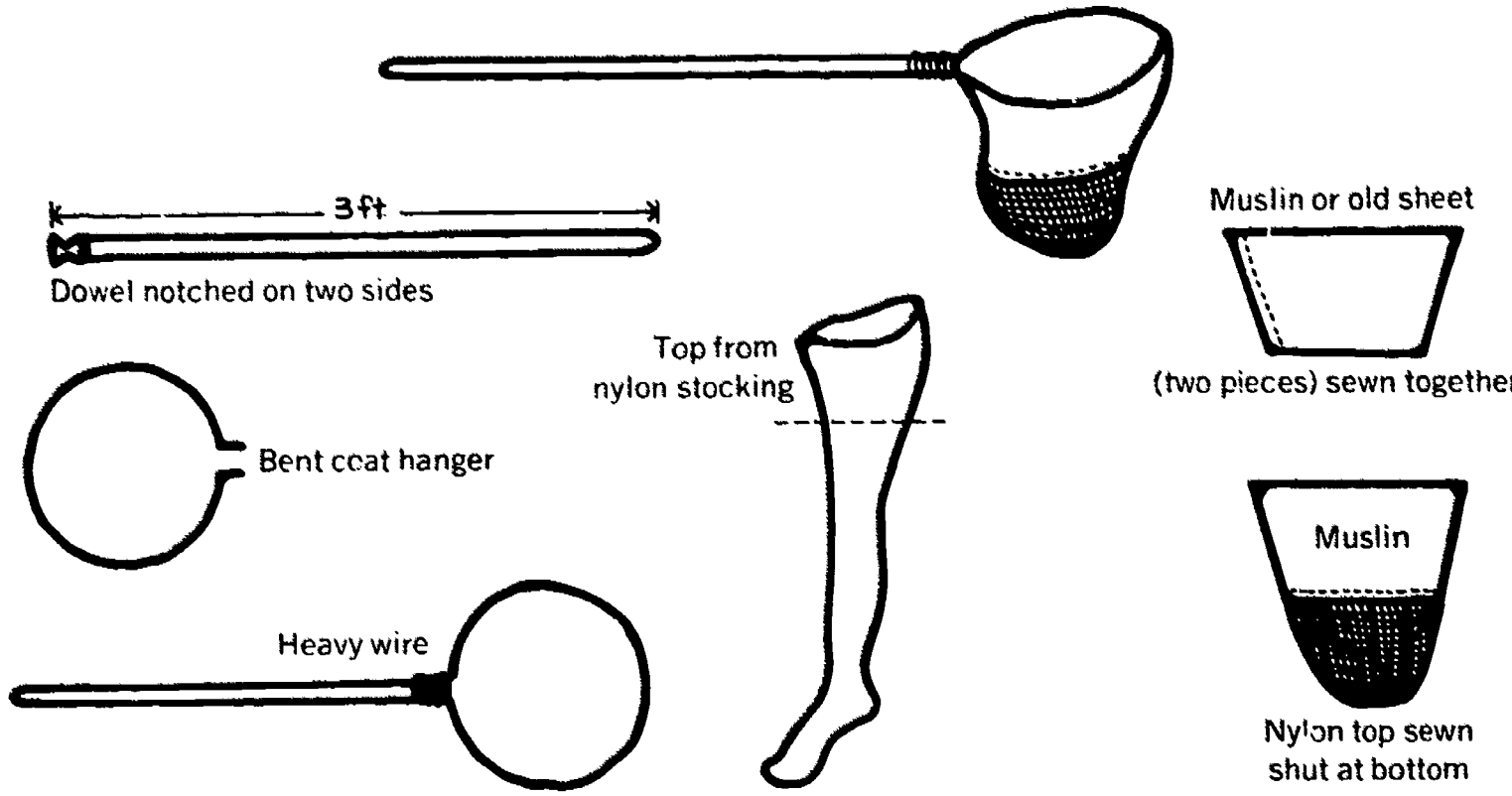
Test No. 2

Preparation I		Preparation II		Preparation III	
MOISTURE	NO MOISTURE	MOISTURE	NO MOISTURE	MOISTURE	NO MOISTURE
Date:		Date:		Date:	
Observations:	Observations:	Observations:	Observations:	Observations:	Observations:
Date:		Date:		Date:	
Observations:	Observations:	Observations:	Observations:	Observations:	Observations:
Date:		Date:		Date:	
Observations:	Observations:	Observations:	Observations:	Observations:	Observations:

Test No. 3

Preparation I		Preparation II		Preparation III	
WARM	COOL	WARM	COOL	WARM	COOL
Date:		Date:		Date:	
Observations:	Observations:	Observations:	Observations:	Observations:	Observations:
Date:		Date:		Date:	
Observations:	Observations:	Observations:	Observations:	Observations:	Observations:
Date:		Date:		Date:	
Observations:	Observations:	Observations:	Observations:	Observations:	Observations:

Insect Net Instructions



Data Sheet for Soil Collection

TEAM MEMBERS: _____

COLLECTION SITE DESCRIPTION: _____

_____

_____

_____

SOIL DESCRIPTION

A. Moisture Content (circle one)

1. **DRY**—crumbly, feels dry, falls apart easily when handled
2. **MOIST**—feels damp or maybe spongy
3. **WET**—drips when picked up or squeezed

B. Soil Texture (circle one)

1. **SANDY**—made up of grains of sand
2. **CLAY**—sticks together in clumps, has lots of clay in it
3. **LOAMY**—made up mostly of dead leaves and other organic matter

Data Sheet for Soil Box Activity

Group: _____ Type of Leaf: _____ Date First chewed upon: _____ Date Half finished: _____ Date Finished: _____	COMMENTS:
Group: _____ Type of Leaf: _____ Date First chewed upon: _____ Date Half finished: _____ Date Finished: _____	COMMENTS:
Group: _____ Type of Leaf: _____ Date First chewed upon: _____ Date Half finished: _____ Date Finished: _____	COMMENTS:
Group: _____ Type of Leaf: _____ Date First chewed upon: _____ Date Half finished: _____ Date Finished: _____	COMMENTS:

THE ENVIRONMENTAL UNITS

Below is a list of the first titles in the Environmental Discovery Series. The ones with order numbers next to them are available as of August, 1972. The others are in preparation and will be available in the coming weeks. Also, ten additional units will be announced soon.

Next to the titles, we have suggested the grades for which each is most appropriate. We emphasize that these are suggested grade levels. The teacher is encouraged to adapt the activities to a wide range of grade levels, and subject areas depending upon the interests and abilities of the students.

Order No.	Title	Grade Level	Price	Order No.	Title	Grade Level	Price
79007	Plants in the Classroom	3-6	$1.50	79123	Genetic Variation	4-9	$1.50
79016	Vacant Lot Studies	5-9	1.50	79132	Soil	2-9	1.50
79025	Differences in Living Things	4-8	1.00	79141	Tile Patterns and Graphs	1-2	1.00
79034	Shadows	1-8	1.00	79150	Plant Puzzles	1-6	1.50
79043	Wind	3-6	1.50	79169	Brine Shrimp and Their Habitat	1-5	1.50
79052	Snow and Ice	1-6	1.50	79178	Nature's Part in Art	3-6	1.50
79061	Man's Habitat—The City	4-9	1.50	79212	Contour Mapping	4-9	1.50
79070	Fish and Water Temperature	4-9	1.50	79187	Change in a Small Ecosystem	5-9	1.50
79089	Oaks, Acorns, Climate and Squirrels	1-6	1.50	79196	Transect Studies	3-9	1.50
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79098	Sampling Button Populations	3-9	1.00	79221	Color and Change	K-2	1.00
79114	The Rise and Fall of a Yeast Community	6-9	1.00	79230	Outdoor Fun for Students	1-12	1.50

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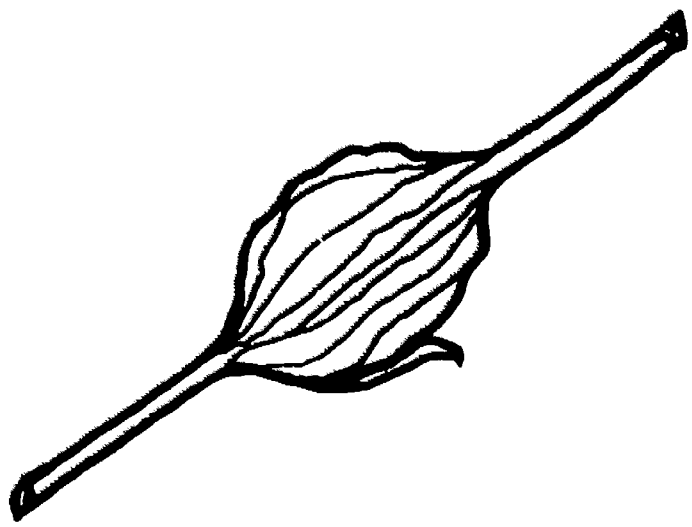

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